UNITED STATES PATENT AND TRADEMARK OFFICE

TW

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,862	11/15/2001	John Davis Holder	MEMC 01-0650 (3003)	4783

321 7590 07/02/2007

SENNIGER POWERS
ONE METROPOLITAN SQUARE
16TH FLOOR
ST LOUIS, MO 63102

EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1722	

NOTIFICATION DATE	DELIVERY MODE
07/02/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspatents@senniger.com

UNITED STATES DEPARTMENT OF COMMERCE
U.S. Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.

EXAMINER

ART UNIT	PAPER

20070620

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

The Nagai et al (US 5,868,835) reference has been added to the evidence relied upon section because Nagai et al is referred to in the discussion of claims 13 and 14 in the grounds of rejection section.

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/002,862
Filing Date: November 15, 2001
Appellant(s): HOLDER, JOHN DAVIS

MAILED
JUL 2 - 2007
GROUP 1700

Paul Fleischut
For Appellant

SUBSTITUTE EXAMINER'S ANSWER

This is in response to the appeal brief filed 12/27/2006 appealing from the Office action mailed 7/14/2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

5,588,993	Holder	12-1996
5,087,429	Kamio et al.	02-1992
5,868,835	Nagai et al.	02-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

1. Claims 1-107 are rejected under 35 U.S.C. 103(a) as being unpatentable over Holder et al (US 5,588,993) in view of Kamio et al (US 5,087,429).

In a method of preparing a molten silicon melt, note entire reference, Holder teaches polycrystalline silicon **10** is loaded into a crucible **20** and chunk poly crystalline silicon is used because using chunks avoids the formation of void defects (col 3, ln 35 to col 4, ln 2). Holder also teaches polycrystalline silicon **10** is melted until a partially melted charge forms in a crucible (col 4, ln 30-65). After forming the partially melted charge in the crucible, granular polycrystalline silicon **40** is fed onto the exposed unmelted polycrystalline silicon (col 5, ln 1-60). Holder also teaches feeding the polycrystalline silicon **40** on the unmelted silicon **11** allows the silicon to dehydrogenate, which is desirable (col 5, ln 10-30).

Holder et al does not teach intermittent feeding.

In a method of manufacturing silicon single crystals, Kamio et al teaches continuously or intermittently feeding a silicon starting material so as to maintain constant the liquid level of the molten material (col 1, ln 5-67), this reads on applicant's intermittent delivery comprising on and off periods.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Holder by using the feeding apparatus taught Kamio for feeding the silicon intermittently to control a desired flow of silicon material.

Also, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Holder by using an intermittent flow because there are only two types of

flow, intermittent or continuous, as evidenced by Kamio et al and the selection of one known equivalent technique for another may be obvious even if the prior art does not expressly suggestion the substitution, *Ex parte Novak* 16 USPQ 2d 2041 (BPAI 1989).

Referring to claim 4-5, the combination of Holder and Kamio et al teach the interface between the unmelted polycrystalline silicon and the upper surface of the molten silicon is approximately equidistant from the center of the unmelted polycrystalline and equidistant from the interior wall of the crucible ('993 Fig 3).

Referring to claim 1, the combination of Holder and Kamio et al teach a feed tube **42** in a crucible, note Figure 2 of Holder et al.

Referring to claims 6-8, the combination of Holder and Kamio et al teach 55 kg of chunk polycrystalline for a 100 kg total charge ('993 col 5, ln 5-15); therefore the percentage of chunk polycrystalline can be determined to be 55% (55/100), which reads on applicant's range of 50-60%.

Referring to claim 9-10, the combination of Holder and Kamio et al teaches the molten silicon comprises about 25-50% of the total surface area ('993 col 4, ln 45-65 and Figs 2-4), this reads on applicant's d ranges about 65%-85% of D.

Referring to claim 11-12, the combination of Holder and Kamio et al teach rotating the crucible ('429 col 6, ln 45-60).

Referring to claim 13-14, the combination of Holder and Kamio et al does not teach rotating at about 2.1 rpm. The rate of crucible rotation is dependant on the flow rate of the feed pipe. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Holder and Kamio et al by optimizing the rotation speed

of the crucible to obtain same by conducting routine experimentation of a result effective variable (MPEP 2144.05). Also, rotating a crucible at 2 rpm is well known in the art, note Nagai et al (US 5,868,835) below. Furthermore, the selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)).

Referring to claim 15-18, the combination of Holder and Kamio et al teaches a feed rate of 5-15 kg/hr ('993 claim 14).

Referring to claim 19-31, the combination of Holder and Kamio et al is silent to the value of the f, t_{on} and t_{off} parameters. The combination of Holder and Kamio et al teaches intermittent feeding ('429 col 1) and the feeding of the silicon is such that a constant level is maintained ('429 col 1). Therefore, the amount of time for commencing and stopping the flow and the flow rate of silicon are result effective variable, which control the thickness of the unmolten layer. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Holder and Kamio et al by optimizing these parameters to obtain same by conducting routine experimentation (MPEP 2144.05).

Referring to claim 32, the combination of Holder and Kamio et al is silent to using an angle of repose valve. Angle of repose valves are conventionally used for granular materials in order to interrupt the flow of granular material. Angle of repose valves are well known in the art, as evidenced by Crawley (US 5,642,751) and Boone et al (US 5,205,998), below.

Referring to claim 33-34, the combination of Holder and Kamio et al teaches a vertical type feed tube so that it is not directly above the center of he exposed unmelted silicon ('993 Figs 2-4).

Referring to claim 35, the combination of Holder and Kamio et al teaches a feed is sprayed ('993 Fig 2-3), this reads on applicant's spray type feed tube.

Referring to claim 36-52, the combination of Holder and Kamio et al is silent to portion of the exposed unmelted polycrystalline silicon upon which the granular polycrystalline silicon is delivered is a wedge that extends radially outward from about the center to the interface between the unmelted silicon and the upper surface of the molten silicon. However, the combination of Holder and Kamio et al teach rotating at a similar rate and flowing granular silicon intermittently, as applicant, therefore this is inherent to the combination of Holder and Kamio et al. The combination of Holder and Kamio et al also does not teach the wedge angle. The wedge angle is merely the size of the wedge. Changes in size and shape are held to be obvious (MPEP 2144.03).

Referring to claim 53-58, the combination of Holder and Kamio et al is silent to the position of wedges. However, the combination of Holder and Kamio et al teach rotating at a similar rate and flowing granular silicon intermittently, as applicant, therefore this is inherent to the combination of Holder and Kamio et al

(10) Response to Argument

The Holder reference teaches a process of preparing a silicon melt in a crucible, which is similar to the process claimed by appellant; the Holder reference was originally invented by the appellant. The primary difference between Holder and the instantly claimed invention is that Holder teaches supplying unmelted polysilicon continuously rather than intermittently. It is also known in the art to deliver silicon starting material continuously or intermittently. The alleged

patentable difference is that the flow is merely stopped for a period of at least one second and turned back on, note page 14, lines 1-3 of Appellant's specification. Furthermore, there is no evidence of record to support an unexpected result by intermittent feeding. The Examiner's position is that it would have been obvious to a person of ordinary skill in the art to modify Hansen by intermittently flowing silicon, as suggested by the prior art.

Group I arguments:

Appellant alleges that a person of ordinary skill in the art would not have been motivated to combine the references because the processes are fundamentally different. The Examiner admits that Holder's process is directed to a process of forming a melt by feeding silicon granules prior to crystal growth and Kamio et al's process is directed to feeding silicon material to maintain a melt level. Appellant is alleging a material difference in the feeding taught by Holder and Kamio et al because of when the feeding occurs, however both processes are directed to the feeding of silicon material to a crucible used in a Czochralski process. The delivery of polysilicon granules continuously or intermittently is known in the art of silicon single crystal manufacturing, See column 1, lines 55 to 65 and column 8, lines 1-20 of Kamio et al. Hansen teaches the manner of feeding polycrystalline is preferably controlled to allow the polycrystalline silicon to dehydrogenate while it resides on the surface of the unmelted polycrystalline silicon before it becomes immersed in the molten silicon, see column 5, lines 10-20. Hansen broadly teaches "the manner of feeding" is controlled to allow for the silicon to dehydrogenate, which would permit intermittent feeding and is not limited to a continuous feed. Appellant alleges that there is no motivation to combine Kamio et al's intermittent feeding with Holder's process. The

ability to control the feed such that silicon material can be feed as needed or desired with an intermittent process would have been obvious to one of ordinary skill in the art.

Appellant's second argument is that intermittent feeding and continuous feeding are not equivalent techniques. Appellant states the process of Hansen and Kamio et al are not equivalent and Appellant even cites the definition of "equivalent" disclosed in *The American Heritage Dictionary of the English Language*. The Examiner's position is that continuous feeding and intermittent feeding are functionally equivalent methods of feeding silicon material to a crucible. Continuous feeding and intermittent feeding are both functionally capable of delivering silicon material at a flow rate between 5 kg/hr and 15 kg/hr, as desired by Hansen, note column 6, lines 5-10. Appellant's argument that the appellant's intermittent feeding of unmelted polycrystalline silicon is superior to the known continuous feeding method is merely an attorney argument which lacks factual support; therefore is not persuasive. It is noted that there is no experimental data disclosed by appellant showing an unexpected result by using intermittent feeding. Appellant merely compares different intermittent feeding conditions and makes general statements that the melting rate was "surprisingly fast" compared to continuous feeding without stating the value of the improvement, see page 4, lines 14-16 and page 24, lines 10-15 of appellant's specification. It should also be noted that appellant teaches that appellant teaches fed by any appropriate method, includes continuous or intermittent delivery, see page 22, lines 22-24 of appellant's specification.

Appellant's intermittent feeding is essentially taking a continuous process feeding and melting silicon and converting the process into several batch processes of feeding silicon and melting. It is well settled in the art that continuous and batch process are interchangeable.

Appellant's argument that the feeding techniques are not equivalent because intermittent feeding cannot achieve the same high quality, i.e. low zero defect yield, ingots is noted but is not found persuasive. First, effects are limited by appellant is the test for equivalency. Continuous and intermittent feeding are functional equivalent which are capable of delivering silicon at a desired flow rate. Second, Hansen teaches a process where feeding silicon granules improved zero dislocation growth, note column 2, lines 61-65. Thus Hansen's process is capable of the desired effect of high quality ingots. Lastly, the alleged effect by appellant is not within the scope of the claimed invention. Appellant's invention does not require the growth of a silicon crystal ingot. Appellant's invention is merely directed to the formation of a silicon melt.

Appellant also alleges that intermittent feeding of unmelted polycrystalline silicon was unknown. Appellant alleges that Kamio et al teaches feeding molten silicon intermittently. Kamio et al teaches continuously or intermittently feeding silicon starting materials, see column 1, lines 55-58. First, Kamio et al clearly suggests unmelted silicon starting materials because solid, unmelted starting materials are known in the art, as evidenced by Hansen. Second, the Japanese references referred to Kamio et al are merely methods known in the art but Kamio's teachings are not limited to embodiments where additional apparatus features are incorporated to the feeder to partial melt the material. Finally, Hansen teaches feeding solid, unmelted polysilicion. The modification is merely to intermittently feed the silicon using Hansen's feeder, as suggested by Kamio et al.

Group II Arguments:

Appellant alleges that the flow rate and time period of the on and off pulses of intermittent delivery are not art recognized result effective variable. Hansen teaches

polycrystalline silicon be fed onto an unmelted polycrystalline silicon at a rate sufficient to allow the resident time and resident temperature of the silicon to allow hydrogen to diffuse from the polycrystalline silicon before becoming immersed in the molten silicon, see column 5, lines 30-40. Hansen also teaches the feeding can be controlled such that it will have a residence time which is adequate to effect dehydrogenation, see column 5, lines 50-53. Also, Hansen teaches a feed rate ranging from 5-15 kg/hr, where low feed rates minimize the thermal stresses on the crucible and thereby minimize crucible degradation. Hansen clearly teaches that flow rate of material is a result effective variable because flow rate directly affect the residence time of the granules which must be sufficient for hydrogen diffusion. The flow rate of an intermittent delivery is going to be dependant on the flow rate, on and off periods of the intermittent delivery. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the prior art by optimizing the flow rate, on and off periods to obtain an optimize flow rate.

Group III arguments:

Appellant alleges that Hansen does not teach a wedge shape. The pile of silicon taught by Hansen in Figure 3 clearly suggests appellant's wedge shape because there is a peak and a slope of silicon down to the melt. Furthermore, as the silicon is intermittently feed separate smaller piles of silicon in a wedge shape will necessarily be formed because the material will build on the underlying wedge shape pile.

Group IV arguments:

Appellant alleges that the prior art does not teach the feature wherein each wedge does not substantially overlap with the immediately preceding wedge. The argument is based on the

prior art not disclosing the flow rate, rotation parameters, on and off periods of the claimed invention. The Examiner's position is that the optimization these parameters are within the skill of a person of ordinary skill in the art because residence time of the granules is dependant of the flow rate conditions of the granules from the feeder. Thus since intermittent flow and rotations are taught by the prior art, independent wedges are necessarily expected to be formed because the rotation in combination with the intermittent flow will produce substantially separate wedges.

Group V arguments:

Appellant alleges the prior art does not teaches pulling a silicon melt. Hansen clearly teaches this feature. Hansen teaches the silicon melt is used in producing single crystal silicon by the Czochralski method and teaches pulling crystals from the melt, see the Abstract and column 8, lines 20-65. Appellant alleges that Kamio teaches maintaining a constant liquid level, however that is merely a piece meal analysis of the reference. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Kamio et al is merely relied upon to teach continuous and intermittent feeding of silicon is known in the art of single crystal manufacturing.

Conclusion:

The primary difference between Holder and the instantly claimed invention is that Holder teaches supplying unmelted polysilicon continuously rather than intermittently. It is also known in the art to delivery silicon material continuously or intermittently, as taught by Kamio et al. The alleged patentable difference is that the silicon granule flow is merely stopped for a period of at least one second and turned back on, note page 14, lines 1-3 of Appellant's specification.

Appellant lacks any evidence of an unexpected result to support patentability. The Examiner maintains that the process of intermittently and continuously feeding silicon material are equivalent functions, thus would have been obvious to one of ordinary skill in the art at the time of the invention.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

6-21-07
DUANE SMITH
SUPERVISORY PATENT EXAMINER

Respectfully submitted,

Matthew Song

Conferees:

Duane Smith

Jennifer Michener

JENNIFER MICHENER
QUALITY ASSURANCE SPECIALIST